

## Volume III

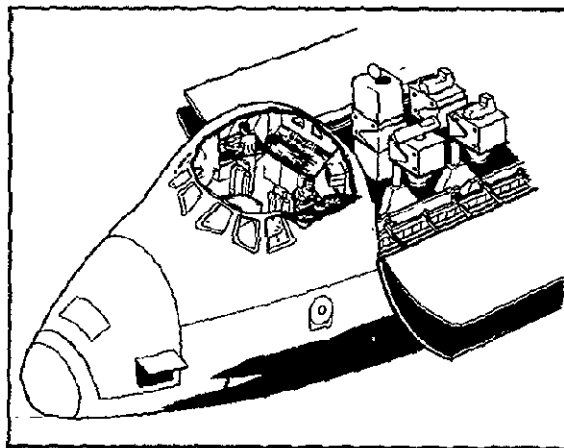
## Final Study Report

November 1976

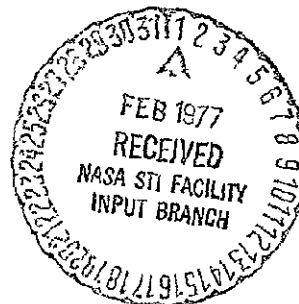
### Program Study Cost Estimates

### Payload Specialist Station Study

### Part I Work Breakdown Structure



(NASA-CR-150134) PAYLOAD SPECIALIST STATION  
STUDY. VOLUME 3: PROGRAM STUDY COST  
ESTIMATES. PART 1: WORK BREAKDOWN  
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**MARTIN MARIETTA**

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Volume III

Final  
Study Report

November 1976

PROGRAM STUDY COST  
ESTIMATES

PAYLOAD SPECIALIST  
STATION STUDY

PART I  
WORK BREAKDOWN  
STRUCTURE

Approved



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FOREWORD

The WBS Dictionary presented herein is submitted in accordance with Data Requirement MA-06 of Data Procurement Document No. 522, Contract NAS8-31789.

## TABLE OF CONTENTS

	<u>Page</u>
1. WORK BREAKDOWN STRUCTURE (WBS) . . . . .	1
2. ELEMENTS OF COST (EOC) . . . . .	1
3. SUBDIVISION OF WORK (SOW) . . . . .	4
4. WBS DICTIONARY . . . . .	6
FIGURE 1 WORK BREAKDOWN STRUCTURE LEVELS FOR PAYLOAD SPECIAL- IST STATION PROGRAM . . . . .	2
TABLE I PSS CONTRACTOR WBS . . . . .	3

## 1. Work Breakdown Structure (WBS) -

In this section the Work Breakdown Structure (WBS) for the Payload Specialist Station (PSS) is presented. Figure 1 describes the WBS levels and reflects the program ground rules and assumptions documented in Volume III, Section 1. At level 3, the WBS is divided into two elements--PSS Contractor and Mission Unique Requirements. In accordance with the study ground rules; it is assumed that a single contractor, hereafter referred to as "PSS Contractor" will perform the following:

- Provide C&D hardware (MFDS and elements of MMSE), except for GFE;
- Identify software requirements;
- Provide GSE and ground test software;
- Perform systems engineering and integration in support of the Aft Flight Deck (AFD) C&D concept.

The PSS Contractor WBS element encompasses a core or standardized PSS concept. Payload peculiar C&D requirements identified by users will originate as a part of the WBS element "Mission Unique Requirements"; these requirements will be provided to the PSS Contractor for implementation.

It should be noted that the above C&D equipment includes all payload/carrier peculiar controls and displays on the Orbiter Aft Flight Deck; therefore, the "PSS" Consoles are not necessarily limited to the Payload Specialist Station.

Table 1 presents the WBS for the PSS Contractor. This WBS is to be used during the PSS design, development and operation phases. For the purpose of the PSS study, "Major Elements" are defined to be WBS level 4 and "Subelements" are WBS level 5.

## 2. Elements of Cost (EOC) -

Each WBS element includes the following "Elements of Cost" where applicable:

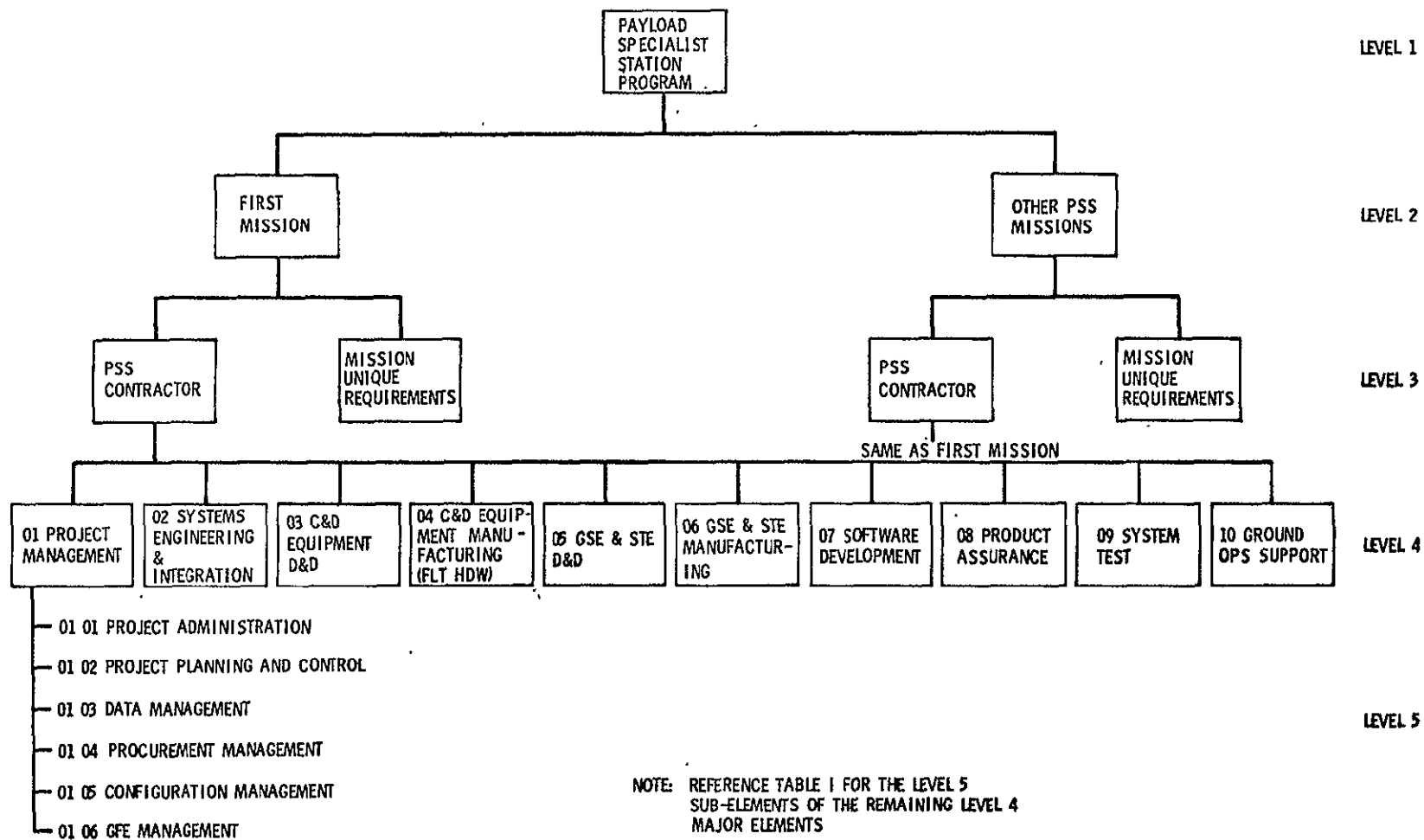


FIGURE 1 WORK BREAKDOWN STRUCTURE LEVELS FOR PAYLOAD SPECIALIST STATION PROGRAM

TABLE 1 PSS CONTRACTOR WBS

MAJOR ELEMENTS	SUBELEMENTS
01 Project Management	01 01 Project Administration 01 02 Project Planning and Control 01 03 Data Management 01 04 Procurement Management 01 05 Configuration Management 01 06 GFE Management
02 Systems Engineering and Integration	02 01 Mission Analysis and Requirements 02 02 System Analysis, Design, and Integration 02 03 Specification and ICDs
03 Control and Display Equipment Design and Development (including Test Hardware other than Flight Hardware)	03 01 Structures and Mechanical 03 02 Controls and Displays 03 03 Electronics 03 04 Electrical Power, Control and Distribution 03 05 Thermal Control
04 Control and Display Equipment Manufacturing (Flight Hardware)	04 01 Structures and Mechanical 04 02 Controls and Displays 04 03 Electronics 04 04 System Assembly, Integration and Checkout
05 GSE and STE D&D	05 01 Electrical 05 02 Mechanical
06 GSE and STE Hardware Manufacturing	06 01 Electrical
07 Software Development	07 01 Flight Software Requirements 07 02 Flight Software for MFDS Processor 07 03 Ground Test Software
08 Product Assurance	08 01 Quality and Reliability 08 02 Safety 08 03 Parts, Materials, and Processes
09 System Test	09 01 System Test Requirements 09 02 System Test Operations (Development Only) 09 03 System Test Verification
10 Ground Operations Support	10 01 PSS C/D Integration and Verification 10 02 Logistics 10 03 Maintenance and Refurbishment

Direct Labor

Engineering  
Manufacturing  
Test  
Quality  
Other

Overhead

(Same breakout as direct)

Major Subcontracts

Materials and Parts

General and Administrative (G&A)

Fee

3. Subdivisions of Work (SOW) -

Codes for the Subdivisions of Work (SOW) within the above Elements of Cost are as follows:

01	Engineering
02	Tooling
03	Manufacturing
05	Quality
06	Test
09	Other Technical Services

The WBS Dictionary uses the above codes to indicate the applicable subdivisions of work. Definitions are as follows:

01. Engineering is the design, development, analysis, evaluation, and redesign of C/D hardware, software, GSE, and associated planning and analysis activities. It includes such activities as the preparation of specifications, drawings, parts list, wiring diagrams, technical coordination between engineering and other activities, vendor coordination, development test planning and scheduling, development test performance, environmental qualification test performance, analysis of test results, data reduction and engineering report preparation. It includes the engineering activities required to support production



and the operational phases. Materials and subcontracts associated with the above activities are included. Direct charge engineering administrative activities have also been included.

02. Tooling includes planning, design fabrication, modification, maintenance, and rework of tools, dies, jigs, fixtures, gages and non-deliverable handling equipment, and work platforms; fabrication of test equipment and interface tooling. It also includes writing and planning tool orders, manufacturing preplanning and process planning, certification of manufacturing processes and personnel, maintaining tool and special test equipment records, preparation of templates, scheduling and controlling tool and STE orders, programming and preparation of tapes for all numerically controlled machine parts, and calibration and periodic maintenance of production and test tooling. It also includes the necessary tooling maintenance and repair during production. Materials and subcontracts associated with the above are included.

03. Manufacturing includes fabrication, assembly refurbishment, processing, reworking, modifications, experimental production, shop support to engineering checkout, preparation of hardware for shipping and preparation of necessary manufacturing associated paper work. Materials and subcontracts associated with the above activities are included. Manufacturing also includes: direct supervision; production control activities such as requisitioning, shop folder control, and floor expediting; and industrial engineering tasks such as budget allocation and control, estimating, and shop load control.

05. Quality Assurance includes: establishment of quality policies. procedures and requirements; quality engineering review of designs, procurement requests, and plans; quality control activities such as receiving inspection, test setup and testing inspection, manufacturing in-line inspection, and inspection of tooling and GSE; certification of quality control personnel; and failure review, analysis, and reporting. Materials associated with the above activities are included.

06. Test prepares test procedures for production configured components, assemblies, subsystems, systems, and software to determine operational characteristics; design test tools and equipment; performs system level installations; verifies the suitability of meeting required criteria; and assures compatibility with the overall system and its intended operational/nonoperational environment. Tests include subsystem bench functional tests and PSS dedicated C/D level acceptance tests. Monitoring tests, data reduction, and report preparation are also included. Materials associated with the above activities are included. This SOW also includes technicians who support various test and launch operations.

09. Other Technical Services include direct management and administrative effort for planning, organizing, coordinating, directing, controlling, and approving that is required to accomplish the program objectives. Effort includes cost management, planning, reproduction, data management of CDRL items, editorial services, procurement administration, facilities planning, property management, and departmental administrative activities.

#### 4. WBS Dictionary -

The purpose of the WBS Dictionary presented herein is to fully define the composition of all WBS elements for purposes of the Payload Specialist Station Study. It is not a statement of work; rather, it provides the enabling words. The dictionary is independent of configuration and program definition. The WBS does not reflect the Martin Marietta Corporation's Phase C/D organization or the cost-accounting system to be implemented in Phase C/D. The definitions provided are to the same level as cost and technical information reported under this contract.

3

**WBS LEVEL**
**WBS NUMBER**

Payload Specialist Station (PSS) Contractor

**WBS TITLE**
**DEFINITION**

The "PSS Contractor" will perform the following:

Provide C&D hardware (MFDS and elements of MMSE), except for GFE;  
Identify software requirements;  
Provide GSE and ground test software;  
Perform systems engineering and integration in support of the Aft Flight Deck (AFD) C&D concept.

**WORK CONTENT**
**SOW NO. \***

Note: PSS C&amp;D equipment includes all payload dedicated displays located on the Orbiter Aft Flight Deck.

The work content for PSS contractor is limited to, but does not necessarily include, all of that described in the following WBS elements:

- 01 Project Management
- 02 Systems Engineering and Integration
- 03 Control and Display Equipment Design and Development
- 04 Control and Display Equipment Manufacturing
- 05 GSE & STE Design and Development
- 06 GSE & STE Hardware Manufacturing
- 07 Software Development
- 08 Product Assurance
- 09 System Test
- 10 Ground Operations Support

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
.06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

**WBS LEVEL**

01

**WBS NUMBER**

Project Management

**WBS TITLE**
**DEFINITION**

Provide direct charge management activities over the PSS Phase C/D project and support NASA to provide and coordinate these activities.

**WORK CONTENT**
**SOW NO.\***

Perform direct charge engineering administrative activities.

01

Provide and coordinate management activities as follows:

09

01 01 Project Administration

01 02 Project Planning and Control

01 03 Data Management

01 04 Procurement Management

01 05 Configuration Management

01 06 GFE Management

\*01 - ENGINEERING; 02 - TOOLING; 03 - MANUFACTURING; 05 - QUALITY  
06 - TEST; 09 - OTHER TECHNICAL SERVICES

5

WBS LEVEL

01 01

WBS NUMBER

Project Administration

WBS TITLE

## DEFINITION

Provide management over the PSS Phase C/D project and support NASA to provide financial management and coordination throughout the program.

## WORK CONTENT

## SOW NO.\*

Engineering Administration will perform engineering support for administrative and performance measurement system activities.

01

Provide administrative activities to include:

09

- Planning, conducting, administering, controlling, and reporting on design-to-cost programs;
- Implementing and maintaining an effective cost and performance measurement control system;
- Implementing and maintaining manpower and cost budgets, and financial controls throughout all program, project, contractor, department, and WBS task levels;
- Trade study and design-to-cost estimating support.

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 06 = QUALITY  
08 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

01 02

**WBS NUMBER**

Project Planning and Controls

**WBS TITLE**
**DEFINITION**

Provide direct charge management planning and controls over the PSS Phase C/D project.

**WORK CONTENT**
**SOW NO.\***

Engineering Administration will perform engineering program planning and control activities.

01

Provide and coordinate overall management control activities to include: program schedules and plans; property management; and other direct charge planning efforts. This task excludes financial control activities (see WBS 01 01).

09

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

WBS LEVEL

01 03

WBS NUMBER

Data Management

WBS TITLE

## DEFINITION

Provide the management and coordination of data including the cost of planning, scheduling, controlling, editing, providing art for, and reproducing Contract Data Items (CDRL Items), review, and presentation documentation.

## WORK CONTENT

## SOW NO.\*

Define documents required (CDRL); prepare and maintain contract documentation schedule and status; monitor responsible organizations and contractors for timely preparation; provide editing and art services as required for data items, reviews and presentations; reproduce and ship as required; coordinate and resolve documentation problems among subcontractors.

09

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

01 04

**WBS NUMBER**

Procurement Management

**WBS TITLE**
**DEFINITION**

Provide management over subcontractor and other procurement administrative and functional direct charge activities on the PSS Phase C/D Program.

**WORK CONTENT**
**SOW NO.\***

Provide management and contractual direction over subcontractors in the implementation of Subcontract Management Plan.

- Coordinate program functional specialist to assure subcontractor's support of program contractual requirements;
- Maintain control and surveillance over subcontractors by directing support from program and material department specialist:
  - Cost Estimating
  - Cost Analysis
  - Technical, Quality, Test Personnel;
- Manage the direct charge procurement activities for the program.

09

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES



5

**WBS LEVEL**

01 05

**WBS NUMBER**

Configuration Management

**WBS TITLE**
**DEFINITION**

Provide configuration analyses, requirements, definition, reviews, and control devices.

Provide the operation of a change integration and configuration control system for the NASA Program Office.

Support Hardware Integration, Software Development, and Test Configuration Management activities.

Provide configuration management over the Phase C/D activity and support NASA to coordinate configuration management activities.

**WORK CONTENT**
**SOW NO.\***

Determine and provide system configuration requirements.

01

Coordinate and maintain: performance and physical characteristics descriptions, master equipment list.

01

Conduct configuration and change control board reviews. Determine configuration control requirements. Control associate contractor configurations and conformance with requirements and support the Integration and Test Configuration Management activities.

01

Maintain a change integration and configuration control program:

09

Support ICD activities, maintain assembly level requirements specification, process change packages, EDCRs, CRs, TCNs, and prepare change control board directives.

Track and account for changes.

09

Support Level II Change Integration Working Group (CIWG) and Level III Configuration Control Board (CCB), and Test Change Notice (TCN) activities.

09

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**01 05**
**WBS NUMBER**
**Configuration Management**
**WBS TITLE**

WORK CONTENT - CONTINUED	SOW NO.*
<p>Access ICD change status relative to schedules and identify significant open items which impact program schedules.</p> <ul style="list-style-type: none"> <li>• Implement, administer and report on the configuration management system consisting of: <ul style="list-style-type: none"> <li>A. Configuration Identification</li> <li>B. Configuration Baseline Definition</li> <li>C. Configuration Control</li> <li>D. Configuration Accounting and Verification</li> <li>E. Acceptance</li> </ul> </li> <li>• Provide plans and procedures for the configuration management and control system.</li> <li>• Conduct contractor Change Control Board review.</li> <li>• Establish and control configurations for supplier and contractor build items.</li> </ul>	<p>09</p>
<p>*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  06 = TEST; 09 = OTHER TECHNICAL SERVICES</p>	

5

**WBS LEVEL**

01 06

**WBS NUMBER**

GFE Management

**WBS TITLE**
**DEFINITION**

Provide management of Government Furnished Equipment (GFE).

**WORK CONTENT**
**SOW NO.\***

Identify and maintain GFE requirements. Coordinate plans and schedules for delivery of GFE. Provide accountability for GFE in custody of the PSS Contractor. Report GFE status.

09

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06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

**WBS LEVEL**

02

**WBS NUMBER**

Systems Engineering and Integration

**WBS TITLE**
**DEFINITION**

Perform systems engineering and integration analysis for the Payload Specialist Station (PSS) including all payload dedicated controls and displays on the Orbiter Aft Flight Deck.

**WORK CONTENT**
**SOW NO.\***

Perform mission analysis, studies, and evaluations to establish control and display (C/D) requirements for the PSS.

Perform systems engineering analysis and design activities including requirements, configuration, compatibility, interface, weight management, and special studies. Conduct design reviews and maintain company standard procedures.

Prepare and maintain specifications and ICDs.

Conduct interface and compatibility analyses; provide coordination between the PSS and payload developers; monitor payload development; coordinate integrated test requirements; and maintain a users handbook.

Level 5 WBS elements are as follows:

- 02 01 Mission Analysis and Requirements
- 02 02 Systems Analysis, Design, and Integration
- 02 03 Specifications and ICDs

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

02 01

**WBS NUMBER**

Mission Analysis and Requirements

**WBS TITLE**
**DEFINITION**

Perform analyses, studies, and evaluations necessary to establish C/D requirement for the PSS.

**WORK CONTENT**
**SOW NO.\***

Analyze mission functional C/D requirements, Orbiter constraints, and mission phase impact on all elements of the PSS.

01

Analyze ground and flight mission operational requirements and constraints and provide design criteria; perform trade studies; define mission operational modes; analyze relationships between PSS capabilities and payload requirements; establish mission operational sequences; allocate functions between ground and on-board; define mission operations requirements on software and hardware.

01

Perform mission operations review activities and provide surveillance over, and control of, subsystem design to assure compatibility with mission operations requirements.

01

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

02 02

**WBS NUMBER**

Systems Analysis, Design, and Integration

**WBS TITLE**
**DEFINITION**

Perform systems engineering analyses and design activities including requirements, configuration, compatibility, interfaces, weight management, and special studies. Conduct design reviews, and maintain company standard procedures.

**WORK CONTENT**
**SOW NO.\***

Perform systems engineering analysis and trade studies to establish and maintain system and subsystem requirements in support of the system and CEI specifications provided in WBS 02 03. Define environmental requirements including radiation and EMI/EMC, vibro acoustics, etc.

01

Conduct configuration analysis, evaluations, and trades. Maintain configuration definition including master equipment lists, system schematics, drawings and layouts, user's handbook documentation, and performance data.

01

Review PSS, Orbiter, Spacelab, and IUS documentation to ensure compatibility and compliance with system requirements. Conduct compatibility analyses and resolve incompatibilities identified.

01

Perform trade studies to optimize software/hardware functional approaches for equipment utilization.

Perform interface analyses between the PSS and the Spacelab, Space Shuttle, IUS and ground systems. Conduct analyses and trade studies to support the ICDs provided in WBS 02 03.

01

Provide analyses and evaluation to establish and maintain the PSS C/D panel weights; provide weight control reports.

01

Perform special engineering analyses and studies as required to develop information needed to make design decisions, evaluate overall system performance, or aid in resolution of program problems.

01

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06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

WBS LEVEL

02 02

WBS NUMBER

Systems Analysis, Design, and Integration

WBS TITLE

WORK CONTENT - CONTINUED	SOW NO.*
Provide design reviews such as PRR, PDR and CDR including scheduling, agenda, chairman/teams, RID preparation and closeout, presentation material, and preparation time. Provide in-house design reviews and other briefings to the Government as may be required.	01
Collect and maintain vendor data.	01
*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY 06 = TEST; 09 = OTHER TECHNICAL SERVICES	

5

**WBS LEVEL**

02 03

**WBS NUMBER**

Specifications and ICDs

**WBS TITLE**
**DEFINITION**

Prepare and maintain specifications, interface control documentation, and a PSS C/D users handbook.

**WORK CONTENT**
**SOW NO.\***

Provide inputs to and prepare/maintain system-level specifications, CEI specifications, Interface Control Documents (ICDs), and a PSS C/D users handbook. Process changes as required. Define and maintain spec tree, format and content. Review specs and ICDs to assure data content; these specifications shall be worked for all applicable hardware and software interfaces.

01

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES



4

**WBS LEVEL**

03

**WBS NUMBER**

Control and Display Equipment Design &amp; Development (D&amp;D)

**WBS TITLE**
**DEFINITION**

Provide design and analysis of the PSS equipment required in support of payload controls and displays on the Orbiter Aft Flight Deck. Provide for and conduct component and subsystem development and qualification testing as required.

**WORK CONTENT**
**SOW NO.\***

Provide design and analyses of the PSS. Provide schematics, diagrams, layouts, and engineering drawings as required. Provide for and conduct component and subsystem development and qualification testing. Provide engineering liaison.

Provide tooling liaison.

Provide advance planning and prepare test procedures for checkout and testing of PSS flight hardware.

Level 5 WBS elements are as follows:

03 01 Structures and Mechanical

03 02 Controls and Displays

03 03 Electronics

03 04 Electrical Power, Control, and Distribution

03 05 Thermal Control

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**03 01**
**WBS NUMBER**
**Structures and Mechanical D&D**
**WBS TITLE**
**DEFINITION**

Provide design and analyses of the structures and mechanical subsystem (S&M). Provide for and conduct component and subsystem development and qualification testing as required. Includes ducting for routing of cabin air for thermal control.

**WORK CONTENT**
**SOW NO.\***

Provide design and analysis of the S&M subsystems. Develop and/or maintain S&M performance, design and interface requirements in support of the specifications and ICDs provided in WBS 02 03.

**01**

Provide schematics; diagrams; layouts; and components, subsystem and system assembly and installation drawings as required. Provide checking and engineering release of the S&M drawings.

**01**

Provide for and conduct component and S&M development testing including test plans and procedures. Conduct test operations and prepare test reports.

**01**

Provide for and conduct component and S&M qualification testing, including test plans and procedures; conduct test operations and provide test reports.

**01**

Provide engineering liaison with tooling, manufacturing, quality and vendors for development and qualification test articles and test equipment.

**01**

Prepare advance planning and prepare test procedures for checkout and testing of S&M flight hardware.

**06**

**\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES**

5

WBS LEVEL

03 02

WBS NUMBER

Controls and Displays D&amp;D

WBS TITLE

## DEFINITION

Provide design and analyses of the Controls and Displays subsystem (C&D). Provide for and conduct component and subsystem development and qualification testing as required.

NOTE: "Controls and Displays" includes the front panels and all C&D equipment located on the front face of the panels.

## WORK CONTENT

## SOW NO.\*

Provide design and analysis of the C&D required to support the mission functional requirements for dedicated C/D equipment to be located at the AFD. Develop and/or maintain C&D performance, design and interface requirements in support of the specifications and ICDs provided in WBS 02 03.

01

Provide schematics; diagrams; layouts; and component subsystem and system assembly and installation drawings as required. Provide checking and engineering release of C&D drawings.

01

Provide for and conduct component and C&D development testing including test plans and procedures. Conduct test operations and prepare test reports.

01

Provide for and conduct component and C&D qualification testing, including test plans and procedures; conduct test operations and provide test reports.

01

Provide engineering liaison with tooling, manufacturing, quality, and vendors for development and qualification test articles and test equipment.

01

Prepare advance planning and prepare test procedures for checkout and testing of C&D flight hardware.

06

\*01 - ENGINEERING; 02 - TOOLING; 03 - MANUFACTURING; 05 - QUALITY  
06 - TEST; 09 - OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

03 03

**WBS NUMBER**

Electronics D&amp;D

**WBS TITLE**
**DEFINITION**

Provide design and analyses of the Electronics (ELEC) subsystem. Provide for and conduct component and subsystem development and qualification testing as required.

NOTE: "Electronics" includes all electronic "black boxes" and equipment/cables located behind the C&D panels.

**WORK CONTENT**
**SOW NO.\***

Provide design and analyses of the ELEC in support of C/D hardware. Develop and/or maintain ELEC performance, design and interface requirements in support of the specifications and ICDs provided in WBS 02 03.

01

Provide schematics; diagrams; layouts; and component, subsystem and system assembly and installation drawings as required. Provide checking and engineering release of ELEC drawings.

01

Provide for and conduct component and ELEC development testing including test plans and procedures. Conduct test operations and prepare test reports.

01

Provide for and conduct component and ELEC qualification testing, including test plans and procedures; conduct test operations and provide test reports.

01

Provide engineering liaison with tooling, manufacturing, quality, and vendors for development and qualification test articles and test equipment.

01

Prepare advance planning and prepare test procedures for checkout and testing of ELEC flight hardware.

06

\*01 - ENGINEERING; 02 - TOOLING; 03 - MANUFACTURING; 06 - QUALITY  
06 - TEST; 09 - OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**03 04**
**WBS NUMBER**
**Electrical Power, Control, and Distribution D&D**
**WBS TITLE**
**DEFINITION**

Provide analyses of the Electrical Power Subsystem (EPS). Provide for and conduct component and subsystem development and qualification testing as required.

**WORK CONTENT**
**SOW NO.\***

Provide design analyses of the EPS in support of the specifications and ICDs provided in WBS 02 03.

**01**

Provide schematics; diagrams; layouts; and components, subsystem and system assembly and installation drawings as required. Provide checking and engineering release of drawings.

**01**

Support C/D component and development testing including test plans and procedures. Conduct test operations and prepare test reports.

**01**

Support C/D component and qualification testing, including test plans and procedures; conduct test operations and provide test reports.

**01**

Provide engineering liaison with tooling, manufacturing, quality, and vendors for development and qualification test articles and test equipment.

**01**

**\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
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5

**WBS LEVEL**

03 05

**WBS NUMBER**

Thermal Control

**WBS TITLE**
**DEFINITION**

Provide analyses of the Thermal Control subsystems (TCS) in support of PSS C/D equipment.

**WORK CONTENT**
**SOW NO.\***

Provide analysis of the TCS and perform thermal mapping of the front panel face in support of PSS C/D equipment located in the Orbiter AFD. Support TCS performance in support of the specifications and ICDs provided in WBS 02 03.

01

Provide for and conduct component TCS development testing including test plans and procedures. Conduct test operations and prepare test reports.

01

Provide for and conduct component TCS qualification testing, including test plans and procedures; conduct test operations and provide test reports.

01

Provide engineering liaison with tooling, manufacturing, quality, and vendors for development and qualification test articles and test equipment.

01

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

**WBS LEVEL**

. 04

**WBS NUMBER**

Control and Display Equipment Manufacturing

**WBS TITLE**
**DEFINITION**

Provide PSS hardware including all tooling needed to fabricate and test the development, qualification and flight units. Provide for and conduct refurbishment of the development unit for use at the Software Development Lab (SDL) and the qualification unit as a payload integration article.

**WORK CONTENT**
**SOW NO.\***

Provide tooling to aid in the fabrication assembly and testing of development, qualification, and flight hardware. Prepare manufacturing process plans and procedures. Provide tooling liaison.

Provide PSS hardware for development and qualification tests.

Perform quality control inspection of PSS hardware provided for development and qualification tests.

Provide engineering liaison.

Provide tooling liaison.

Procure, fabricate and assemble PSS hardware.

Refurbish development and qualification units.

Perform quality control inspection of PSS hardware.

Perform acceptance and production testing of PSS hardware.

Level 5 WBS elements are as follows:

- 04 01 Structures and Mechanical Hardware Manufacturing
- 04 02 Controls and Displays Hardware Manufacturing
- 04 03 Electronics Hardware Manufacturing
- 04 04 System Assembly, Integration and Checkout

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**04 01**
**WBS NUMBER**
**Structures and Mechanical Hardware Manufacturing**
**WBS TITLE**
**DEFINITION**

Provide structures and mechanical subsystem (S&M) hardware for development, qualification and flight articles. Provide refurbishment hardware for development and qualification articles.

**WORK CONTENT**
**SOW NO.\***

Provide engineering liaison with manufacturing, test, quality and vendors during procurement and manufacturing, assembly, and production testing of S&M flight hardware.

**01**

Design, fabricate and/or procure S&M tooling to aid in detail fabrication, assembly, and testing of development, qualification, and flight hardware.

**02**

Prepare S&M manufacturing process plans and procedures and perform manufacturing preplanning and review of engineering drawings.

**02**

Provide tooling liaison with manufacturing during fabrication and assembly of S&M development and qualification test articles and during conduct of development and qualification testing.

**02**

Procure, fabricate and assemble S&M development, qualification and flight hardware. Procure raw materials and parts as required. Includes manufacturing supervision normal production allowance (NPA), production control and industrial engineering liaison as applicable.

**03**

Perform quality control inspection during receiving inspection and fabrication, assembly and production testing of S&M hardware.

**05**

Perform acceptance and production testing of S&M hardware. Maintain test procedures and provide test records.

**06**

**\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES**



**5**
**WBS LEVEL**
**04 02**
**WBS NUMBER**
**Controls and Displays Hardware Manufacturing**
**WBS TITLE**
**DEFINITION**

Provide controls and displays subsystem (C&D) for the development, qualification and flight hardware.

NOTE: "Controls and Displays" includes the front panels and all C&D equipment located on the front face of the panels.

Provide refurbishment of development unit for a trainer article and refurbishment of the qualification unit for a payload integration article.

**WORK CONTENT**
**SOW NO.\***

Provide engineering liaison with manufacturing, test, quality and vendors during procurement and/or manufacturing, assembly, and production testing of C&D flight hardware.	01
Design, fabricate, and/or procure C&D tooling to aid in detail fabrication, assembly, and testing of development, qualification and flight hardware.	02
Prepare C&D manufacturing process plans and procedures and perform manufacturing preplanning and review of engineering drawings.	02
Provide tooling floor liaison with manufacturing during fabrication, assembly and production testing of C&D flight hardware.	02
Procure, fabricate and assemble C&D development, qualification and flight hardware. Procure raw materials and parts as required. Includes manufacturing supervision normal production allowance (NPA), production control, and industrial engineering liaison as applicable.	03
Perform quality control inspection during receiving inspection and fabrication, assembly, and production testing of C&D flight hardware.	05
Refurbish development and qualification hardware for acceptance.	03
Perform acceptance and production testing of C&D flight hardware. Maintain test procedures and provide test records.	06

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**04 03**
**WBS LEVEL**
**WBS NUMBER**
**Electronics Hardware Manufacturing**
**WBS TITLE**
**DEFINITION**

Provide data electronics (ELEC) development, qualification and flight hardware.

NOTE: "Electronics" includes all electronics "black boxes" and equipment located behind the C&D panels.

Provide refurbishment of development unit for a trainer and the qualification unit for a payload integration article.

**WORK CONTENT**
**SOW NO.\***

Provide engineering liaison with manufacturing, test, quality and vendors during procurement and/or manufacturing, assembly, and production testing of ELEC hardware.

**01**

Design, fabricate, and/or prepare ELEC tooling to aid in detail fabrication, assembly, and testing of development, qualification, and flight hardware.

**02**

Prepare ELEC manufacturing process plans and procedures and perform manufacturing preplanning and review of engineering drawings.

**02**

Provide tooling floor liaison with manufacturing during fabrication, assembly and production testing of ELEC hardware.

**02**

Procure, fabricate and assemble ELEC development, qualification and flight hardware. Procure raw materials and parts as required. Includes manufacturing supervision normal production allowance (NPA), production control, and industrial engineering liaison as applicable.

**03**

Perform quality control inspection during receiving inspection and fabrication, assembly, and production testing of ELEC development, qualification and hardware. Refurbish development and qualification hardware.

**05**

Perform acceptance and production testing of ELEC hardware. Maintain test procedures and provide test records.

**06**

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**04 04**
**WBS NUMBER**
**System Assembly, Integration and Checkout**
**WBS TITLE**
**DEFINITION**

Provide system assembly, integration and checkout of PSS development, qualification and flight hardware including all payload dedicated control and display equipment located in the Orbiter Aft Flight Deck.

Provide assembly, integration and checkout of refurbished development and qualification units for acceptance as a trainer and payload integration articles.

**WORK CONTENT**
**SOW NO.\***

Provide engineering liaison with manufacturing, test, and quality during assembly, and production/acceptance testing of PSS development, qualification and flight hardware.

**01**

Provide tooling floor liaison with manufacturing during assembly and production/acceptance testing of PSS hardware.

**02**

Assemble PSS development, qualification and flight hardware. Procure raw materials and parts as required. Includes manufacturing supervision normal production allowance (NPA), production control, and industrial engineering liaison as applicable.

**03**

Perform assembly and material procurement for refurbishment of development and qualification units.

**03**

Perform quality control inspection during receiving inspection and/or assembly, and production/acceptance testing of PSS hardware.

**05**

Perform production/acceptance testing of PSS hardware to include thermal control and electrical power acceptance verification. Maintain test procedures and provide test records.

**06**

**\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES**

4

**WBS LEVEL**

05

**WBS NUMBER**

GSE &amp; STE Design and Development (D&amp;D)

**WBS TITLE**
**DEFINITION**

Determine and maintain GSE & STE requirements for the PSS. Design/develop GSE/STE.

**WORK CONTENT**
**SOW NO.\***

Provide analyses/studies of GSE/STE requirements for the PSS. Define and track GSE/STE requirements. Design/develop GSE and STE.

Provide tooling for fabrication and assembly of GSE and STE.

Level 5 WBS elements are as follows:

05 01 Electrical GSE & STE D&D

05 02 Mechanical GSE & STE D&D

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

05 01

**WBS NUMBER**

Electrical GSE &amp; STE D&amp;D

**WBS TITLE**
**DEFINITION**

Determine and maintain electrical GSE and STE requirements for the PSS.  
Design/develop electrical GSE/STE.

**WORK CONTENT**
**SOW NO.\***

Analyze requirements and perform trade studies as required to identify GSE and STE. Define and track electrical GSE/STE requirements including identification, quantity, usage, description, specifications, etc., for each end item. Perform engineering analysis of GSE/STE to insure cost effective design meets all hardware requirements. Perform necessary trade studies.

01

Provide schematics; diagrams; layouts; and engineering drawings of electrical GSE/STE as required. Provide modification instructions where applicable. Provide checking and engineering release of drawings.

01

Provide for and conduct development testing as required.

01

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

**WBS LEVEL**

06

**WBS NUMBER**

GSE &amp; STE Hardware Manufacturing

**WBS TITLE**
**DEFINITION**

Provide GSE &amp; STE hardware.

**WORK CONTENT**
**SOW NO.\***

Provide engineering liaison.

Provide tooling liaison.

Procure and/or fabricate tooling.

Procure and/or fabricate and assemble GSE &amp; STE hardware.

Perform quality control inspection of GSE &amp; STE hardware.

Perform acceptance and production testing of GSE &amp; STE hardware.

Level 5 WBS elements are as follows:

06 01 Electrical GSE &amp; STE Hardware Manufacturing.

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

06 01

**WBS NUMBER**

Electrical GSE &amp; STE Hardware Manufacturing

**WBS TITLE**
**DEFINITION**

Provide electrical GSE &amp; STE hardware.

**WORK CONTENT**
**SOW NO.\***

Provide engineering liaison with manufacturing, test, quality and vendors during procurement and/or manufacturing, assembly, and production testing of electrical GSE &amp; STE hardware.

01

Provide tooling for manufacturing and testing of electrical GSE &amp; STE hardware.

02

Procure and/or fabricate and assemble electrical GSE and STE hardware. Procure raw materials and parts as required. Includes manufacturing supervision normal production allowance (NPA), production control, and industrial engineering liaison as applicable.

03

Perform quality control inspection during receiving inspection and fabrication, assembly, and production testing of electrical GSE &amp; STE hardware.

05

Perform acceptance and production testing of electrical GSE/STE hardware. Maintain test procedures and provide test records.

06

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

**WBS LEVEL**

07

**WBS NUMBER**

Software Development

**WBS TITLE**
**DEFINITION**

Develop flight C&D software requirements. Provide flight C&D software for the MFDS processor. Provide ground test software.

**WORK CONTENT**
**SOW NO.\***

Develop flight C&D requirements for PSS software. Provide MFDS processor flight-software and ground test software computer programs including formats, tapes, discs, etc.

Level 5 WBS elements are as follows:

- 07 01 . Software Requirements
- 07 02 Flight Software Development for MFDS processor
- 07 03 Ground Test Software Development

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES



**5**
**WBS LEVEL**
**07 01**
**WBS NUMBER**
**Flight Software Requirements**
**WBS TITLE**
**DEFINITION**

Develop flight C&D requirements for PSS software.

**WORK CONTENT**
**SOW NO.\***

Perform engineering analysis of PSS requirements and guidelines, GSE requirements, payload, STS, Spacelab and IUS requirements, specifications, interface criteria, experiment interfaces, data processing requirements, operations requirements and criteria in order to define the PSS program software.

**01**

Support trade studies (WBS 02 02) to optimize software/hardware functional approaches for equipment utilization. Perform trade studies to optimize the split of flight C&D software between the MFDS processor and the CDMS computers.

**01**

Prepare flight C&D software requirements for both the Spacelab CDMS and the MFDS processors.

**01**

Prepare ground test software requirements for both GSE and Spacelab CDMS computers to check the AFD C&D "core" equipment.

**01**

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**07 02**
**WBS NUMBER**
**Flight Software Development for MFDS Processor**
**WBS TITLE**
**DEFINITION**

Provide flight C&D software for MFDS processor.

**WORK CONTENT**
**SOW NO.\***

For that portion of the flight C&D software which is resident in the MFDS processor, prepare and provide the following:

**01**

Development test plan;  
 Software specifications (code to type, flow charts, etc.);  
 Code programs in specified computer language;  
 Verification and Validation test procedures;  
 Final software report;  
 Computer programs and formats including discs, tapes, etc;  
 Computer program description document;  
 Computer program listing.

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
 06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

07 03

**WBS NUMBER**

Ground Test Software Development

**WBS TITLE**
**DEFINITION**

Provide ground test software.

**WORK CONTENT**
**SOW NO.\***

Develop ground software programs for GSE used for acceptance test and subsequent G&amp;D verification.

01

This development shall include: a software development plan; software specification; coding of programs; preparation of verification test procedures; software verification/validation testing and a final report. In addition a program description document together with program listings shall be provided.

01

\*01 - ENGINEERING; 02 - TOOLING; 03 - MANUFACTURING; 05 - QUALITY  
06 - TEST; 09 - OTHER TECHNICAL SERVICES

**4**
**WBS LEVEL**
**08**
**WBS NUMBER**
**Product Assurance**
**WBS TITLE**
**DEFINITION**

Provide a product assurance program including quality and reliability, safety, and parts, materials and processes.

**WORK CONTENT**
**SOW NO.\***

Establish and maintain reliability and maintainability requirements. Conduct reliability and maintainability analyses.

Define quality assurance requirements; implement quality requirements.

Prepare analyses of all potential hazards and assure their elimination or control through design or operational constraints.

Provide parts, materials and processes analyses, requirements, and documentation.

Level 5 WBS elements are as follows:

- 08 01 Quality and Reliability
- 08 02 Safety
- 08 03 Parts, Materials, and Processes

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

08 01

**WBS NUMBER**

Quality and Reliability

**WBS TITLE**
**DEFINITION**

Establish and maintain reliability and maintainability requirements. Conduct reliability and maintainability analyses. Define quality assurance requirements. Implement a quality program.

**WORK CONTENT**
**SOW NO.\***

Review PSS design and establish/maintain reliability and maintainability requirements. Monitor PSS design activities to insure compliance with requirements. Perform FMEA to identify and minimize single point failures. Review life limited items and identify maintainability requirements. Prepare PSS reliability and maintainability plan.

01

Establish reliability and maintainability design criteria including redundancy requirements, life limited items and requirements in support of CEI specifications. Perform tradeoffs to evaluate alternate design approaches. Prepare critical item list. Perform design and subcontractor reviews and control activities to insure compliance with reliability requirements.

01

Provide Quality Assurance requirements for the PSS Quality Engineering, Quality Assurance Management, Quality Vendor Surveillance, Quality Reviews, CEI Acceptance Data Package. Conduct quality review of PSS design and specification; prepare quality test planning activities; support make or buy committee; participate in vendor surveys and selection. Review and monitor implementation; prepare end item acceptance data package; conduct analysis for defective items and data; support control board; implement quality assurance control of vendors and subcontractors; review test reports; monitor inhouse certifications; perform periodic quality audits; and, in general, perform all quality assurance activities other than inspection of hardware and acceptance tests which are covered under each applicable WBS task.

05

Provide a corrective action center displaying all nonconformance, failure analysis status and correction actions required.

09

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**08 02**
**WBS NUMBER**
**Safety**
**WBS TITLE**
**DEFINITION**

Prepare analyses of all potential hazards and assure their elimination or control through design or operational constraints.

**WORK CONTENT**
**SOW NO.\***

Evaluate safety aspects of all PSS elements and operations and prepare and maintain risk management data in composite form for management review and decision making purposes. This data shall be based on the review and evaluation of such data as hazard analyses, FMEAs, maintenance analyses, progress reports and milestone review data packages. Such evaluations shall be performed to verify effectiveness of corrective actions established to eliminate or control identified risks and hazards. This effort shall include the performance of systems safety compatibility analyses, interface hazard analyses, and statusing and tracking of safety related problems and preparation of recommendations to resolve identified discrepancies.

**01**

Review and approve test plans and procedures for hazardous operations. Conduct required test surveillance to assure compliance with safety requirements.

**01**

Develop PSS C&D safety compliance data packages.

**01**

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

WBS LEVEL

08 03

WBS NUMBER

Parts, Materials, and Processes

WBS TITLE

## DEFINITION

Provide parts, materials and processes, analyses, requirements and documentation.

## WORK CONTENT

## SOW NO.\*

Perform analyses of parts, materials, and processes requirements; analyze existing inhouse and vendor processes, plans, and procedures, and write new ones as required. Implement a material and process control program. Monitor vendors, sub-contractors, and inhouse efforts for compliance. Perform test activities as necessary.

01

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

4

**WBS LEVEL**

09

**WBS NUMBER**

System Test

**WBS TITLE**
**DEFINITION**

Provide system test requirements. Provide system development tests, and support ground test operations.

**WORK CONTENT**
**SOW NO.\***

Perform analyses and trade studies to define the verification program for the PSS.

Provide system development tests involving more than one WBS subelement. Prepare test procedures for PSS inputs to test procedures for KSC operations.

Level 5 WBS elements are as follows:

09 01 System Test Requirements

09 02 System Test Operations

09 03 System Test Verification

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
08 = TEST; 09 = OTHER TECHNICAL SERVICES



5

**WBS LEVEL**

09 01

**WBS NUMBER**

System Test Requirements

**WBS TITLE**
**DEFINITION**

Perform analyses and trade studies to define the verification program for the PSS.

**WORK CONTENT**
**SOW NO.\***

Perform analyses, studies, and evaluations to support preparation of test plans for PSS equipment. Provide PSS C/D verification requirements, specifications, and required environmental tests. Define test support requirements including: facilities and equipment, bench setups, test software, and interface equipment.

01

Review test data for compliance with design requirements.

01

Provide component qualification and acceptance test planning. Update and finalize verification concepts; perform trade studies; produce concept risk assessments; and update and perform following analyses:

01

- Evaluate design, manufacturing, verification, and operations cycles;
- Evaluate the need for incremental verification of each part, component, subsystem, software, and the system;
- Determine types and fidelities of test hardware and equipment for design verification and operations;
- Define cost-avoidance component qualification approaches;
- Identify components requiring development, qualification, and life testing;
- Provide piece parts program plan and requirements.
- Provide checkout requirements and procedures for KSC/WTR operations.

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 06 = QUALITY  
08 = TEST; 09 = OTHER TECHNICAL SERVICES

**5**
**WBS LEVEL**
**09 02**
**WBS NUMBER**
**System Test Operations**
**WBS TITLE**
**DEFINITION**

Provide system development tests involving more than one WBS subelement. Prepare installation and test procedures for PSS equipment and inputs to integrated test procedures.

**WORK CONTENT**
**SOW NO.\***

Provide quality inspection of system test articles, test setups and system test operations.

**05**

Prepare test procedures for system development tests and PSS integration. Provide test procedure inputs for integrated test procedures.

**01**

Conduct system development tests involving more than one WBS subelement.

**01**

Provide for system development tests involving more than one WBS subelement including: definition of detail test requirements, design of test articles and test setups, and test reports.

**01**

Provide engineering liaison during procurement, manufacture, and assembly of system test articles and the conduct of system test operations.

**01**

**\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES**

**5**
**WBS LEVEL**
**09 03**
**WBS NUMBER**
**System Test Verification**
**WBS TITLE**
**DEFINITION**

Support systems test on the development unit, qualification unit, and flight units. This includes installation and acceptance test utilizing the GSE.

**WORK CONTENT**
**SOW NO.\***

Provide on-site (Denver) engineering support of test operations at MSFC and KSC.

**01**

Perform analyses of test data and prepare inputs to test reports.

**01**

Review test anomalies and perform analyses as required.

**01**

Provide engineering liaison between discipline operations at MSFC and KSC.

**01**

Provide system operational checks of GSE.

**06**

Provide engineering support for the GSE installation and checkout at MSFC and KSC.

**01**

Provide maintenance support of GSE.

**01**

Provide acceptance and operational support for GSE reviews and provide inputs to data packages.

**01**

**\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES**

4

**WBS LEVEL**

10

**WBS NUMBER**

Ground Operations Support

**WBS TITLE**
**DEFINITION**

Provide field support for the PSS C/D equipment during launch operations. Provide logistics support including transportation, spares, and refurbishment of PSS equipment.

**WORK CONTENT**
**SOW NO.\***

Provide field support at KSC/WTR for the test and checkout of the PSS C/D flight articles with the payloads.

Perform logistics planning, Provide transportation and spares for the PSS equipment including logistics management and accountability functions.

Provide maintenance, repair, and refurbishment of PSS flight hardware and GSE.

Level 5 WBS elements are as follows:

- 10 01 PSS C/D Integration and Verification
- 10 02 Logistics
- 10 03 Maintenance and Refurbishment

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

10 01

**WBS NUMBER**

PSS C/D Integration and Verification

**WBS TITLE**
**DEFINITION**

Provide field support at KSC/WTR for the test and checkout of the PSS flight articles with the payloads.

**WORK CONTENT**
**SOW NO.\***

Provide engineering field support at WTR/KSC for the integration of the PSS flight articles with the payloads and test verification.

01

Provide test support at WTR/KSC for the test and checkout of the PSS flight articles with the payload and test verification. Maintain inputs to integrated procedures. Provide troubleshooting procedures and services as required.

06

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

10 02

**WBS NUMBER**

Logistics

**WBS TITLE**
**DEFINITION**

Perform logistics planning. Provide transportation and spares for the PSS, including logistics management and accountability functions.

**WORK CONTENT**
**SOW NO.\***

Perform logistics planning and prepare an Integrated Support Plan. Perform maintainability, maintenance and optimum repair level analyses to determine maintenance plan and requirements. Perform Support Requirements Analysis (SRA) to determine support requirements, including spares, supplies, tools, equipment, facilities and technical documentation. Establish handling and transportation plans.

01

Pack and ship PSS flight articles, spares, and GSE. Provide shipping instructions. Transport to destination.

03

Provide engineering support during packing and shipping.

01

Provide quality inspection during packing and shipping.

05

Provide engineering liaison with manufacturing, test, quality and vendors during procurement and/or manufacturing, assembly, and production testing of spares.

01

Provide tooling floor liaison with manufacturing during fabrication, assembly and production testing of spares.

02

Procure and/or fabricate and assemble spares. Procure raw materials and parts as required. Includes manufacturing supervision normal production allowance (NPA), production control, and industrial engineering liaison as applicable.

03

Perform acceptance and/or production testing of spares. Maintain test procedures and provide test records.

06

\*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  
06 = TEST; 09 = OTHER TECHNICAL SERVICES

5

**WBS LEVEL**

10 02

**WBS NUMBER**

Logistics

**WBS TITLE**

WORK CONTENT - CONTINUED	SOW NO.*
<p>(NOTE: If development/qual test hardware is refurbished for spares the initial manufacturing cost is included under this WBS (equivalent production cost); refurbishment costs are included in WBS 03.</p> <p>Provide logistics storage, accountability, and inventory of spares.</p>	03
<p>*01 = ENGINEERING; 02 = TOOLING; 03 = MANUFACTURING; 05 = QUALITY  06 = TEST; 09 = OTHER TECHNICAL SERVICES</p>	

5

**WBS LEVEL**

10 03

**WBS NUMBER**

Maintenance and Refurbishment

**WBS TITLE**
**DEFINITION**

Provide maintenance, repair, and refurbishment of PSS flight hardware and GSE.

**WORK CONTENT**
**SOW NO.\***

Provide maintenance and refurbishment of C&amp;D equipment including modification and reverification as required.

03

Provide maintenance and refurbishment of GSE and GSE test software.

03

\*01 - ENGINEERING; 02 - TOOLING; 03 - MANUFACTURING; 05 - QUALITY  
06 - TEST; 09 - OTHER TECHNICAL SERVICES